Lesson 04

ListPlot

Let us import that data from the last problem in the Assignment03. Remember to set the directory first.

SetDirectory["Yeshiva"]
SetDirectory["ANGEL"]
SetDirectory["Presentations_Computational"]

Clear[ xt, yt, xy ];
xt = Import[ "TimeHorizontal.dat", "Table" ];
yt = Import[ "TimeVertical.dat", "Table" ];
xy = Import[ "HorizontalVertical.dat", "Table" ];

Now let us make plots with the data

p1 = ListPlot[ xt ]
p2 = ListPlot[ yt ]
Show[p1, p2]
pp = ListPlot[ { xt, yt } ]

Alternatives to the outcome

p1 = ListPlot[ xt , PlotStyle -> PointSize[.02] ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]} ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { 0, 20 } ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { { 0, 2 }, { 0, 20 } } ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "Horizontal Position (m)"}]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "x (m)"}, LabelStyle -> Directive[ Black, Bold, Medium ] , PlotLabel -> "Horizontal component of the projectile motion" ]

line1 = ListPlot[ xt , Joined -> True, PlotStyle -> Green, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "x (m)"}, LabelStyle -> Directive[ Black, Bold, Medium ] ,PlotLabel -> "Horizontal component of the projectile motion" ]
line1 = ListPlot[ xt , Joined -> True, PlotStyle -> {Thick, Green}, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "x (m)"}, LabelStyle -> Directive[ Black, Bold, Medium ] ,PlotLabel -> "Horizontal component of the projectile motion" ]
Show[ {p1, line1} ]
Show[ {line1, p1} ]

- Make a plot for the trajectory of the projectile with each recorded position represented by a blue circle. Give a name to the plot.
pxy = ListPlot[ xy , PlotStyle -> {Blue,PointSize[.02]}, PlotRange -> All , AxesLabel -> { "Horizontal Position (m)" , "Vertical Position (m)"} , LabelStyle -> Directive[ Black, Bold, Medium ] ,PlotLabel -> "Trajectory of the projectile" ]

- By clicking on top of it, you can make the plot bigger by dragging the edge with the mouse.

- You can add additional features to your plot, by choosing Graphics -> Drawing Tools
- Other examples:
  Clear[squares];
  squares = Table[ k^2, { k, 1, 20 } ];
  ListPlot[ squares, PlotStyle -> PointSize[ 0.03 ] ]

  Clear[rand];
  rand = Table[ RandomInteger[ { 1, 20 } ], { k, 1, 30 } ];
  ListPlot[ rand ]
  ListPlot[ rand, Filling -> Axis ]
  ListPlot[ rand, Joined -> True ]

- Charts

  The monthly sales of a certain store (in thousands of dollars) were

  JAN  FEB  MAR  APR  MAY  JUNE  JULY  AUG  SEPT  OCT  NOV  DEC
  5.2  6.3  7.12  13.4  12.6  19.7  20.2  22.6  16.2  15.0  18.4  23.9

  Clear[months,salesdata];
  salesdata = {5.2, 6.3, 7.12, 13.4, 12.6, 19.7, 20.2, 22.6, 16.2, 15.0, 18.4, 23.9};

  BarChart[salesdata, ChartLabels -> months]
  PieChart[salesdata, ChartLabels -> months]

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**Plot**

If instead of a list we have a function, we use Plot, instead of ListPlot

### 2D plots

Plot[Cos[x], {x, -10, 10}]

Plot[Cos[x], {x, -10, 10}, PlotRange -> {-2, 2}]

Plot[Cos[x], {x, -10, 10}, PlotRange -> {{-20, 20}, {-2, 2}}]

co=Plot[Cos[x], {x, -10, 10}, PlotRange -> {{-20, 20}, {-2, 2}}, PlotStyle -> Blue]

si=Plot[Sin[x], {x, -10, 10}, PlotRange -> {{-20, 20}, {-2, 2}}, PlotStyle -> Red]

Show[{co,si}]

Plot[ {Cos[x], Sin[x], Sin[x]^2}, {x, -3, 3}]

Plot[ {Cos[x], Sin[x], Sin[x]^2}, {x, -3, 3}, PlotRange -> {-1.5, 1.5}, PlotStyle -> {Red, Black, Blue} ]

Plot[ {Cos[x], Sin[x], Sin[x]^2}, {x, -3, 3}, PlotRange -> {-1.5, 1.5}, PlotStyle -> {{Red, Thickness[0.02]}, {Black, Thickness[0.01]}, {Blue, Dashed}} ]

- To get legends, we need to load a package
**Manipulate and animation**

Suppose we want to know how a constant "a" affects the plot of a sine function.

*) We could use a do-loop and look at the result for various values

```math
Do[
Print[Plot[Sin[a x], {x, 0, 2 Pi}]]; , {a, 1, 5}]
```

*) An even better way is to use "Manipulate"

```math
Manipulate[Plot[Sin[a x], {x, 0, 2 Pi}], {a, 1, 5}]
```

*) Two plots together

```math
Manipulate[Column[{Plot[Sin[a x], {x, 0, 2 Pi}], Plot[Sin[2 a x], {x, 0, 2 Pi}]}], {a, 1, 5}]
```

*) We can also make a movie. For this we need several snapshots of the image

```math
Clear[anima]; anima = Animate[Plot[Sin[a x], {x, 0, 2 Pi}, PlotStyle -> {Blue, Thick}, AxesLabel -> \"Sin\" , "x"\}, LabelStyle -> Directive[Black, Bold, Medium]], {a, 1, 5}]
```

*) And the movie can also be exported.

(remember to choose the folder where it goes)

```math
Export[\"Movie_Sin.avi\", anima, \"AVI\"]
```

*) Variable is time (to be used next combined with a geometric figure)

```math
Animate[Plot[Sin[ x - t (2 Pi/8)], {x, - 4 Pi, 4 Pi}], {t, 0, 7}]
```

*) With geometric figures:

```math
Graphics[ {PointSize[0.05], Point[{0, 0}]}, PlotRange -> {-1, 1}] Graphics[{PointSize[0.05], Point[{0, 0}]}, {PointSize[0.05], Red, Point[{0, 0.5}]}], PlotRange -> {-1, 1}]
```

```math
Animate[Graphics[{PointSize[0.05], Point[{0, a}]}, PlotRange -> {-1, 1}], {a, -1, 1}]
```
Animate[Graphics[{PointSize[0.05], Point[{0, Sin[a]}]}, PlotRange -> {-1, 1}, {a, 0, 2 Pi}]

Animate[Graphics[{PointSize[0.05], Point[{0, Sin[-t (2 Pi/8)]}]}, PlotRange -> {-1, 1}, {t, 0, 7}]

Show[Plot[Sin[x - t (2 Pi/8)], {x, -4 Pi, 4 Pi}], Graphics[{PointSize[0.05], Point[{0, Sin[-t (2 Pi/8)]}]}]]

Show[Plot[Sin[x - 0.5 (2 Pi/8)], {x, -4 Pi, 4 Pi}], Graphics[{PointSize[0.05], Point[{0, Sin[-0.5 (2 Pi/8)]}]}]]

*) Wave and geometric figure together:
Animate[Show[Plot[Sin[x - t (2 Pi/8)], {x, -4 Pi, 4 Pi}], Graphics[{PointSize[0.05], Point[{0, Sin[-t (2 Pi/8)]}]}]], {t, 0, 7}]

Try to solve the problems about interference of Assignment04 together in class.